Article Citation

NOTE: You may copy the stable URLs and paste them into an online bibliography, syllabus, or other web page.

The Determination of Long-Term Credit Standing with Financial Ratios
James O. Horrigan
Journal of Accounting Research, Vol. 4, Empirical Research in Accounting: Selected Studies 1966. (1966), pp. 44-62.
Stable URL:
http://links.jstor.org/sici?sici=0021-8456%281966%294%3C44%3ATDOLCS%3E2.0.CO

The Determination of Long-Term Credit Standing with Financial Ratios

JAMES O. HORRIGAN*

INTRODUCTION

The general concern of this paper is the utility of accounting data in long-term credit administration. This utility is examined here by an evaluation of the predictive power of accounting data in regard to corporate bond ratings. Accounting data in absolute form are of quite limited utility because they usually provide only one piece of information, the size of a firm. That is to say, the various items in the financial statements of a typical sample of firms are usually highly correlated with each other.[1] Therefore, accounting data must be transformed before they can be used in multivariate analysis. The usual types of transformations are trends, in the case of time-series analyses, and financial ratios, in the case of cross-sectional analyses. The specific concern of this paper is the latter type of transformation—financial ratios. Financial ratios have suffered much criticism in the accounting literature, as well as elsewhere. But it is clear that the utility of financial accounting in general rests on the usefulness of these ratios. Thus, the question here is: Can accounting data, especially in the form of financial ratios, be used to assist in long-term credit-administration decisions?

ORGANIZATION OF THE ANALYSIS

The samples.—This question was explored through an analysis of the financial ratios of American manufacturing corporations with bond issues rated by Moody's Investors Service and/or Standard & Poor's Corporation. An initial sample was made up of firms whose bond ratings

* Assistant Professor of Accounting, University of Notre Dame.

[1] For example, it has been this author's experience in empirical work that the coefficients of simple correlation among the various components of balance sheets and income statements tend to be in a .8 to .9 range.

did not change during the period 1959–64. This sample included 201 firms with stable Moody's ratings and 151 firms with stable Standard & Poor's ratings.[2] The results obtained from this initial sample were applied to subsequent samples of two types: (1) firms who received bond ratings during the period 1961–64; and (2) firms whose previously assigned ratings were changed during 1961–64. These subsequent samples consisted of 70 and 60 firms who received new ratings from Moody's and Standard & Poor's respectively, and 27 and 58 firms whose ratings were changed by Moody's and Standard & Poor's.[3] In general, the ratings assigned by these two rating agencies were quite similar,[4] but I thought it worthwhile to investigate them separately to see if any small, but important, differences might exist.

The dependent variable.—In any study dealing with a question of the utility of accounting data, the development of an appropriate dependent variable is difficult. In long-term credit administration, the major interest is the ability of the creditor to repay long-term debt. The ideal dependent variable would be a measure which could be scaled on a continuum ranging from certain repayment through certain default. Such a variable obviously does not exist. However, a fairly efficient surrogate measure of long-term credit-worthiness is available in the guise of corporate bond ratings. Thus, these ratings were adopted as the dependent variable of this study.[5]

Since the selection of a dependent variable is crucial, it is worthwhile to consider some of the characteristics of these bond ratings. As a dependent variable, the ratings are particularly attractive because

[2] There was considerable overlap between these two groups; 137 of the firms were rated by both of the agencies. Also, these figures are not necessarily a good approximation of the number of firms rated by those agencies. Rather, they represent the number of firms, with adequate accounting data, which were rated in the following sources: (1) *Moody's Industrial Manual* (New York: Moody's Investor Service, 1960 and 1961); (2) *Standard & Poor's Earnings and Ratings Bond Guide* (New York: Standard & Poor's Corporation, December, year-end, 1959 and 1960).

[3] These samples were obtained from announcements in the following sources: (1) *Moody's Bond Survey* (New York: Moody's Investor Service); (2) *Bond Outlook* (New York: Standard & Poor's Corporation).

[4] For example, in an earlier analysis of a larger initial sample, the simple coefficient of determination between the two sets of ratings was .85, and the regression relationship indicated Moody's ratings tended to be slightly lower than Standard & Poor's. (Moody's rating $= 1.03 + .83$ S & P rating)

[5] These ratings are given in an alphabetical form, and so they had to be converted to a numerical form before they could be used in this study. This was done by assigning a nine-point scale running from 9 for Moody's Aaa rating and Standard & Poor's AAA through 1 for the C rating of both agencies. It is generally agreed that the two agencies' ratings scales are equivalent, but Standard & Poor's does have three additional ratings in a rarely used D class. Nine-point scales have been used in the previous studies of bond ratings. It is assumed that a nine-point system measures the relative differences between ratings actually intended by the agencies, but this assumption may be a pitfall.

TABLE 1

Default Rates of Corporate Bonds in the Hickman and Harold Studies

Rating	Hickman: 1900–43[a]	Harold: 1929–35[b]
	%	%
IX	0.4	1.0
VIII	3.2	8.0
VII	8.8	18.0
VI	18.5	14.0
V	32.7[c]	28.0
IV		50.0
N	not given	301

[a] W. B. Hickman, *Corporate Bond Quality and Investor Experience*, p. 176. Industrial firms only.
[b] G. Harold, *Bond Ratings as an Investment Guide*, p. 144.
[c] Classes I-V combined.

they have been found to be good predictors of bond defaults. Hickman's excellent study is the most notable.[6] In his analysis of the experiences of corporate bonds during the period 1900–43, he indicated, "The record of the agencies over the period studied was remarkably good in so far as their ratings pertain to the risk of default."[7] Consistently, an inverse relationship was noted between the bond ratings and default rates. Also, he found that the capital loss on default, as measured by the difference between par value and the market value at default, was inversely related to the ratings. Harold's study of corporate-bond experiences during 1929–35 also revealed the same patterns.[8] (See Table 1 for some findings of these studies.) In a slightly different study, Burrell investigated income interruptions and market-value changes of corporate bonds for the period 1927–34.[9] He found that the proportions of corporate bonds whose income was interrupted and whose market values suffered relatively greater declines were inversely related to bond ratings. On the basis of this past evidence, it would seem that corporate-bond ratings can serve well as measures of the probability of default and even as rough predictors of the magnitude of the losses at default.

An important characteristic of bond ratings, as such, is the nature of their statistical distribution. A tabulation made in the initial phase of my study which includes the ratings of all industrial firms, not just

[6] W. Braddock Hickman, *Corporate Bond Quality and Investor Experience* (Princeton: Princeton University Press, for the National Bureau of Economic Research, 1958), pp. 139–210.
[7] *Ibid.*, p. 141.
[8] Gilbert Harold, *Bond Ratings as an Investment Guide* (New York: The Ronald Press, 1938), pp. 93–106; 141–46.
[9] O. K. Burrell, *A Study in Investment Mortality* (University of Oregon: Bureau of Business Research, School of Business Administration, May, 1947), pp. 10–11.

TABLE 2

Corporate Bond Ratings of Firms with Stable Ratings During 1959–60[a]

Rating	Moody's		Standard & Poor's	
	N	%	N	%
IX	7	2.5	32	7.8
VIII	32	11.8	22	9.5
VII	64	23.6	56	24.2
VI	58	21.4	56	24.2
V	68	25.1	57	24.6
IV	41	15.1	21	9.0
III	1	0.4	2	0.9
	271	100.0	232	100.0

[a] These represent the highest rating assigned to each firm.

manufacturing firms, provides the most comprehensive picture. This tabulation, which is presented in Table 2, indicates that the median rating of both agencies was VI—that is, Baa and BBB—and that the distributions were roughly symmetrical. However, it also appears as though the distributions were bimodal, or perhaps even trimodal, which may mean there is more than one population of bond ratings.[10]

The characteristics of the bond-rating process are also of interest here. Understandably, the rating agencies have never divulged the precise nature of their bond-rating analyses; but the rough outlines of their appraisal systems can be determined.

Standard & Poor's breaks its analysis down into two primary components: earnings protection and assets protection.[11] It does prepare financial ratios which measure those two components directly, but it does not limit itself only to accounting data in its analyses. When analyzing earnings protection, this agency also considers such items as the nature of a firm's industry, its competitive position, its product, and its research and promotion expenditures. When analyzing asset protection, it also examines such items as the firm's asset structure, its plant efficiency, its capital expenditures, and its patent protection. All of this information is evaluated in light of the character of the firm's management, which may well be a third primary component, and it is projected into the future. In the latter regard, Standard & Poor's is particularly reputed to give greater weight to forecasts of future growth in its ratings.[12] Finan-

[10] As shall be explained later in this study, a legal feature of bonds, subordination vs. nonsubordination, does seem to divide bond ratings into two different populations.

[11] This description is based on a letter from Mr. Louis Brand, Assistant Vice President, Standard & Poor's Corporation, dated November 11, 1965. Some of this information can also be found in their data services—e.g., *Standard Corporation Descriptions: T–Z* (New York: Standard & Poor's Corp.).

[12] "Wall Street: Assessing Gilt," *Time* (New York), December 25, 1964, p. 58.

cial statements should capture much of this additional information in a general way; but Mr. Louis Brand, a senior rater at Standard & Poor's, feels that "numbers derived from the financial statements will give a rating, but not necessarily the proper one." [13]

Moody's is reputed to be more conservative in its ratings, but it considers similar items. It says it weighs such items as statistical factors, industry trends, financial practices and policies, cyclical stability of the industry, holdings of intangible assets, managerial quality, competition within the industry, and the various bond-indenture features.[14] Moody's, in particular, rejects the idea that its rating system can be reduced to a quantitative formula. It stresses that it gives great weight to nonstatistical factors—that is, nonquantifiable factors—and its chief rater, Mr. Edmund Vogelius, is quoted as saying: "It is a judgment of analysts. No computer can come up with a rating" [15] Thus, the dependent variable in this study is particularly challenging.

The independent variables.—Many independent variables were considered in this study. All of these variables, except one, were drawn from accounting data. The sole nonaccounting variable used was a 0-1 dummy-variable measure of the subordination status of a bond issue (SUB). Total assets (TA), which was used as a measure of size of firm, was the only piece of absolute accounting data employed. The remaining variables drawn from accounting data were all in the form of financial ratios. These were not new or unusual financial ratios. They represented a consensus of the ratios recommended by several sources which deal with financial-statement analysis in various contexts. Thus, they might be described as "traditional" financial ratios.

To facilitate the analysis, a simple taxonomical model of the firm was used to group the financial ratios. The ratios are grouped essentially into liquidity and profitability categories. The liquidity category has been broken down further into time divisions of short-term liquidity and long-term solvency; and the profitability category has been further classified along the lines of the DuPont return on investment analysis, as follows: short-term capital turnover; long-term capital turnover; profit margin; and return on investment. The ratios in each of these groups are listed in Table 3.

Certain characteristics of the financial-ratios variables pose problems.[16] Firstly, these ratios are highly intercorrelated with each other, especially within the categories spelled out above. This collinearity means, of

[13] *Op. cit.*, letter from Mr. Louis Brand, November 11, 1965.

[14] Edmund L. Vogelius, "Bond Ratings," *The Commercial and Financial Chronicle*, CLXXII (August 24, 1950) 4, 19–20.

[15] "Wall Street . . .," *loc. cit.*

[16] For a complete discussion, see: James O. Horrigan, "Some Empirical Bases of Financial Ratio Analysis," *The Accounting Review*, XL (July, 1965), 558–68.

TABLE 3

Financial Ratio Variables

Symbol	Description
1. Short-term Liquidity Ratios	
C/CD	cash plus marketable securities to current debt;
QA/CD	current assets less inventory to current debt ("quick ratio");
CA/CD	current assets to current debt ("current ratio").
2. Long-term Solvency Ratios	
NW/TD	net worth to total debt;
NW/LD	net worth to long-term debt;
NW/FA	net worth to fixed assets;
OI/I	net operating profits to interest ("times-interest-earned ratio").
3. Short-term Capital Turnover Ratios	
S/AR	sales to accounts receivable;
S/IN	sales to inventory;
S/WC	sales to working capital.*
4. Long-term Capital Turnover Ratios	
S/FA	sales to fixed assets;
S/TA	sales to total assets;
S/NW	sales to net worth.
5. Profit Margin Ratios	
OI/S	net operating profits to sales;
NI/S	net profits to sales.
6. Return on Investment Ratios	
OI/TA	net operating profits to total assets;
NI/NW	net profits to net worth.

* This ratio was inverted in the study because some firms had negative working capital.

course, that careful, parsimonious selection must be carried out when determining which financial ratios should be used in an analysis.

Secondly, distributions of financial ratios tend to be significantly correlated over time. This means that the ratios are not likely to be efficient predictors of dependent variables which shift in a random pattern over time, such as stock-market prices. Fortunately, this particular aspect appears to be an advantageous feature in this study. The dependent variable tends not to change over time; and thus, any relationships found should have predictive value.

Finally, it is commonly held that there are a large number of factors which may unduly increase the dispersion of financial ratios. These factors include such items as size of firm, industry classification, cyclical conditions, seasonal conditions, and location of the firm. These factors can be dealt with either by inserting them as additional independent variables, by adjusting the data for their effect, or by stratifying the sample. The latter method was rejected because some of the resulting stratified samples would have been too small.

Size of firm was handled in this study by introducing it as a separate

TABLE 4

Significant Correlations between Size of Firm and Financial Ratios: 1960[a]

Ratios	Correlation Coefficients: Moody's Sample	Correlation Coefficients: Std. & Poor's Sample
CA/CD	−.145	−.163
NW/TD	.184	.194
OI/I	.284	.279
S/NW	−.168	−.166
OI/S	.264	.225
NI/S	.225	.181
OI/TA	.178	.166

[a] Size of firm is measured by total assets. All relationships are significant at the <.05 level.

independent variable. It did not seem particularly efficient to adjust the other data for firm size because less than half of the financial ratios were significantly related to size (total assets) and those relationships were not particularly powerful. The significant relationships are presented in Table 4.

The remaining factors, except the location of firm factor, were incorporated into the analysis by adjusting the financial ratio of each individual firm with its industry's ratio.[17] The industry ratios were computed, as closely as possible, for the fiscal period of each firm, so that they serve as a rough adjustment for cyclical and seasonal conditions as well as for industry classifications. Two types of adjustments were made with these industry ratios. The difference between a firm's ratio and its industry ratio was divided by the industry ratio; and the difference between a firm's ratio and its industry ratio, *without regard for the sign of the difference*, was divided by the industry ratio. The first type of adjusted ratio shall be referred to as "industry-adjusted ratios" and the second type as "parabolic, industry-adjusted ratios."[18] The performance of regular, unadjusted ratios was compared with both these types of adjusted ratios to determine, insofar as possible, the actual importance of such factors as industry classification.

These industry-adjusted ratios should also shed some light on the question of what types of criteria should be used in financial-ratio analysis. The literature generally specifies two types of criteria: absolute

[17] The industry data came from two-digit classification categories in the following source: FTC-SEC, *Quarterly Financial Report for Manufacturing Corporations* (1959–63).

[18] The prefix "A" will precede ratio symbols to designate the simple type of industry adjustment and "P" will precede the parabolic type. For example, CA/CD would designate the unadjusted current ratio, A/CA/CD the percentage of a firm's current ratio difference from the industry ratio to the industry ratio, and P/CA/CD the same percentage without regard for the sign of the difference.

and relative. The famous 2-to-1 criterion for the current ratio is an example of the absolute type. Any specification that a ratio should be higher than its industry-average ratio would be an example of the relative type. However, the relative type of criteria can also be parabolic—that is, a very high *and* a very low ratio may be considered unfavorable, or perhaps favorable. Presumably, the industry-adjusted ratios should perform better in those cases where relative criteria are appropriate, and the unadjusted ratios should perform better if absolute criteria are relevant.

The analyses.—The general approach followed in the analysis of these variables was multiple regression of the bond ratings on various combinations of the independent variables. The regression functions chosen were the ones which contained the combinations of variables which were most highly correlated with the bond ratings and whose regression coefficients were most reliable. These selected regression functions were then used to make predictions from new sets of data.

The first stage in this analysis was the determination of each of the simple correlations between the ratings and the independent variables and of the simple intercorrelations among the independent variables. The financial ratios and other variables most highly correlated with the bond ratings were initially selected as the best variables; but insofar as possible, highly intercorrelated ratios were eliminated from the analysis.[19] At this point, I examined the possibility that certain independent variables not significantly correlated with the bond ratings might be related in a useful fashion with other independent variables. No such variables of this type were retained after the subsequent multivariate analyses were performed because none of them proved to be useful. In general, this stage was essentially an elimination of those variables which would only clutter the analysis.

The second stage of the analysis was the computation of the multiple regressions of the bond ratings on various combinations of the independent variables selected in the first stage. This, of course, was the stage in which the best functions were chosen.

The third stage consisted of a test of the selected regression functions with new data. This was done by preparing single-figure indexes from the data in the original samples. These indexes were actually the means of the estimated dependent variables, less the intercept constant, for each rating class. That is, the variables of each firm were multiplied by their respective regression coefficients and the products were summed into an "index." The area between the mean index of each rating class was divided in half to determine the limits of each rating group.[20] Finally,

[19] The regression program used was not a stepwise program, so this was largely a process of judgment by the author.

[20] Other approaches were tried, such as utilizing the standard errors of the regression coefficients, but this simple approach proved to be as efficient as any.

these interval bond-rating indexes were then used to predict the ratings of new samples of firms involving new bond issues and bond-rating changes; and the number of correct and incorrect predictions were analyzed.

THE HYPOTHESES

The hypotheses tested in the above analysis can be set out simply, as follows:

1. *The short-term liquidity ratios are not significantly related to the bond ratings.* Presumably, these ratios measure the ability of a firm to pay debt in the short run and would, at the most, play a very minor role in the determination of bond ratings.
2. *The long-term solvency ratios are significantly related to the bond ratings in a positive manner.* However, these ratios tend to be highly intercorrelated and probably only one ratio in this category will be necessary. Also, it is presumed that the differences in these ratios among manufacturing industries are not significant; and therefore, unadjusted ratios will serve as well as industry-adjusted ratios, if not better.
3. *The short-term capital turnover ratios are significantly related to the bond ratings but to a modest extent, compared to the other categories of significantly related ratios.* A significant relationship is expected here because these ratios do determine, in part, the level of a firm's return on investment; but the relationship is expected to be modest because they do not supply much information about the long-run impact of turnover upon earnings.

   The nature of this expected relationship is not simple. These ratios vary widely among industries, and so it is expected that industry-adjusted ratios will perform better. In this respect, the parabolic, industry-adjusted ratios are expected to be the most efficient. Short-term turnover ratios which are very high or very low relative to their industry-average ratios are expected to be inversely related to bond ratings. This is essentially an empirical notion that firms in an industry will tend to cluster about an optimum level of a ratio of this type; and therefore, an average ratio would be a good estimate of the optimum level.

   Intercorrelations are not so severe a problem in this category as in the others; but, in general, the working capital turnover ratio is expected to be the most useful ratio here because it captures most of the information in the category.
4. *The long-term capital turnover ratios are also significantly related to the bond ratings and to a much greater extent than are the short-term turnover ratios.* These ratios are expected to perform relatively better, because they supply more fundamental, long-run information about the impact of turnover upon earnings. It is also expected here that the parabolic, industry-adjusted ratios will be more efficient and the relationships will be negative. Intercorrelation of the ratios is a particular problem within this category, and probably a single ratio of this type will suffice.
5. *Profit-margin ratios are also expected to be significantly related to bond ratings in a positive fashion.* The precise nature of this relationship is also somewhat difficult to specify. Since return on investment is the product of profit margin and turnover, it would seem that these profit-margin ratios are equivocal in nature, similar to the turnover ratios. These ratios also vary fairly widely among industries, and so parabolic, industry-adjusted ratios would seem appropriate at first glance.

   However, it is expected here that profit margins higher than a firm's industry-average ratio will be associated with the higher bond ratings. Turnover ratios, especially long term, are considered as stable variables in this context; and thus, the firm must manipulate profit margin to deal with changing conditions which affect earnings. Hence, industry-adjusted profit-margin ratios will be the most efficient.

6. *The returns on investment ratios are also expected to be significantly related to the bond ratings in a positive fashion.* These ratios also vary among industries in some cases. Therefore, it is possible that industry-adjusted ratios would be useful here; but it is clear that parabolic, industry-adjusted ratios would be inappropriate.
7. *Finally, size of firm, as measured by total assets, will be significantly related to the bond ratings in a positive fashion.* Size of firm is viewed essentially as a relative constant here. The financial ratios serve as rough measures of a firm's risk class, but it is assumed that the fluctuations associated with risk are dampened by larger firm size. That is, if two firms have equal financial ratios, their bond ratings may still differ if there is a large difference between the sizes of the firms. Thus, this is expected to be a very important variable.

In general, these hypotheses imply that higher bond ratings would be assigned to large firms whose long-term solvency ratios are high, whose profit-margin and return-on-investment ratios are higher than the industry average, and whose capital-turnover ratios are close to the industry average.

THE RESULTS OF THE ANALYSIS

First stage: selection of the variables.—In general, the stated hypotheses were confirmed. The simple correlations between the bond ratings and the independent variables were largely as expected. (See Table 5 for

TABLE 5

Correlations of Independent Variables with Bond Ratings: 1960 Data[a]

Variable	Correlation Coefficients	
	Moody's Sample	Std. & Poor's Sample
P/C/CD	−.187	−.277
P/QA/CD	−.180	−.296
P/CA/CD	−.180	−.267
NW/TD	.424	.466
NW/LD	.319*	.369
P/NW/FA	−.218	−.265
OI/I	.405	.438
S/AR	.152	—
S/IN	—	—
P/WC/S	−.216	−.286
P/S/FA	−.321	−.265**
P/S/TA	−.265	−.206
P/S/NW	−.397	−.338
OI/S	.449	.383
NI/S	.360	.267
OI/TA	.430	.385
NI/NW	.228	.220
TA	.478	.479

[a] Ratings are the highest assigned to each firm. All correlations are significant at the $<.05$ level.

* The industry-adjusted form, A/NW/LD, was the highest in this case.

** The unadjusted ratio, S/FA, was the highest in this case.

a presentation of those relationships.) However, there were three major exceptions. First, the parabolic, industry-adjusted form of short-term liquidity ratios did turn out to be significantly related to the ratings. This is surprising, because it is doubtful that these particular ratios have long-run predictive value. It is likely this is a spurious relationship, but the possibility must be allowed that these short-term liquidity ratios do play some part in long-term credit-rating determination. Second, only one short-term capital turnover was definitely related to the bond ratings. It appears as though accounts receivable and inventory turnover are not involved significantly in the determination of bond ratings. Third, the unadjusted form of the profit-margin and return-on-investment ratios was more efficient. This, however, was a result of incomparable data. It was not possible to make the industry profit data equivalent to the profit data developed in my samples. None of these exceptions seemed particularly damaging to the original set of hypotheses, and so no changes were made in the analysis at this point.

The most important part of this stage of the analysis was the reduction of the many independent variables to just a few variables. It was an implicit hypothesis that the ratio categories described above would be the basis of sorting out these variables. That is, it was expected that the collinearity of the ratios would tend to exist mainly within those categories. The intercorrelations among the financial ratios of a particular set of data are presented in Table 6.

As can be seen in Table 6, there were a somewhat bewildering number of significant intercorrelations among the ratios. In particular, the long-term capital-turnover, the profit-margin, and the return-on-investment ratios were related to many other ratios outside their categories. However, the larger intercorrelations were within the specified categories. There was an important exception, though. It was clear that the working-capital-turnover ratio really should have been classified as a short-term liquidity ratio; it was treated as if it were both a short-term liquidity and short-term capital-turnover ratio in the remainder of the study. Another exception observed here was the very high intercorrelations between the profit-margin ratios and the return-on-investment ratios, but this was not too surprising. These two categories were reduced to a single category, "profit ratios," for the balance of the analysis.[21] Therefore, there were four ratio categories remaining at this point: short-term capital-turnover ratios; long-term capital-turnover ratios; long-term solvency ratios; and profit ratios.

Second stage: selection of the best function.—Various combinations of

[21] An interesting minor exception is the net-worth-to-fixed-assets ratio. It was highly related to fixed-assets turnover and slightly related to a few other ratios. It clearly does not belong in the long-term solvency category, but its proper classification is a puzzle. This ratio's role is quite ambiguous, and it does not seem amenable to any type of functional classification system.

TABLE 6

Intercorrelations of Financial Ratios; Moody's Sample: 1960 Data[a]

Ratios	Correlation Coefficients								
	QA/CD	CA/CD	NW/TD	NW/LD	NW/FA	OI/I	S/AR	S/IN	WC/S
C/CD	.863	.639	.331						.635
QA/CD	—	.804	.356				−.146		.665
CA/CD		—	.358		.241			−.230	.728
NW/TD			—	.764		.609			
NW/LD				—		.886			
NW/FA					—				.306
OI/I						—			
S/AR							—	.151	−.260
S/IN								—	−.347
WC/S									—

	S/FA	S/TA	S/NW	OI/S	NI/S	OI/TA	NI/NW
C/CD	−.148	−.275	−.349	.319	.428		
QA/CD	−.145	−.230	−.360	.224	.339		
CA/CD		−.180	−.370				
NW/TD	−.249	−.195	−.464	.318	.308	.212	.139
NW/LD			−.206	.266	.239	.237	
NW/FA	.806	.209					
OI/I			−.179	.399	.307	.439	.205
S/AR		.446	.147			.244	
S/IN		.364	.320			.139	
WC/S		−.426	−.400	.150	.326		
S/FA	—	.520	.577	−.284	−.250		−.150
S/TA		—	.742	−.363	−.288		
S/NW			—	−.488	−.421	−.232	−.255
OI/S				—	.809	.797	.618
NI/S					—	.580	.727
OI/TA						—	.684

[a] All correlations are significant at the <.05 level.

financial ratios from those categories were examined, and as might be expected, a combination comprising the ratio in each category most highly correlated with the bond ratings proved to be the best. Interestingly enough, this meant the same group of variables was the best for both rating agencies. Along with total assets (TA), the following ratios were adopted as the best model for predicting bond ratings: working capital to sales (P/WC/S); net worth to total debt (NW/TD); sales to net worth (P/S/NW); and net operating profits to sales (OI/S).

The rationale of this model is that it contains an optimum amount of information with only four ratios. The working-capital-turnover ratio represents both short-term liquidity and short-term capital turnover; the net-worth-to-total-debt ratio represents long-term solvency;

and the net-operating-profits-to-sales ratio and the sales-to-net-worth ratio represent profit margin and long-term capital turnover, respectively, whose product in turn would measure return on investment.[22] Given the presence of intercorrelation among the various ratios, this model, or some variation of it, probably represents the maximum amount of information which can be squeezed out of financial ratios.

The actual regression functions for this model are presented in Table 7. Two comments about that table are in order here. First, the results from the 1960 data are remarkably similar between the two rating agencies. Size of firm was the most important variable and long-term solvency (NW/TD) was the most important ratio category. However, there is a difference in the results from the 1959 data. Net worth to total debt was the most important variable in Standard and Poor's ratings, but it was of lesser importance in Moody's ratings. The overall model was still the best one in each year, however.[23] Second, the multiple coefficients of determination (r^2) suggest that an analyst could correctly classify slightly under half of the ratings with this model and would presumably be able to predict new ratings with equal success. Greater accuracy would be desirable, of course; but this simple model would certainly be a very useful starting point in an analysis of a firm's long-term credit standing.

During this part of the analysis, the previously mentioned bimodal nature of the bond ratings was considered. One perplexing problem was quite evident. Some firms with more than one bond issue outstanding had received different ratings on the issues. It appeared as though a legal feature of the bonds, subordination vs. nonsubordination, was causing the differences in the ratings. Subordinated bonds seemed to be usually rated one rating lower than nonsubordinated bonds. Correspondence with bond raters at the two agencies confirmed that this is indeed generally the case.[24]

Three alternative approaches for handling this problem were tried: inserting a 0-1 dummy variable, with 0 representing subordinated ratings; raising the ratings of subordinated bonds one rating; and dividing the sample into subordinated and nonsubordinated samples. The latter approach, stratifying the sample, did work well, but it resulted in dif-

[22] The latter point is dubious in one regard, however. Since the S/NW ratio was used, the counterpart profit-margin ratio should have been NI/S because the product would have then been NI/NW. (S/NW × NI/S = NI/NW.) However, the NI/S ratio was not as efficient as OI/S, mainly because the net-profits data developed were not as reliable as the net operating-profits data. Therefore, the OI/S ratio was used instead.

[23] To simplify the exposition, only the 1960 data results will be used beyond this point.

[24] Letters from Louis Brand, Assistant Vice President, Standard & Poor's Corporation, July 23, 1965, and Albert C. Esokait, Industrial Bond Specialist, Moody's Investor Service, August 6, 1965.

TABLE 7

The Relationship of Corporate Bond Ratings to Total Assets and Four Financial Ratios: 1959–60

Variable	Regression Coefficient	t Value of Reg. Coef.	Multiple Coefficient of Determination
Moody's: 1960			
TA*	.0348	6.06	.23
NW/TD	.232	4.10	.35
OI/S	4.551	4.11	.41
P/WC/S	−.377	−.360	.45
P/S/NW	−.346	−3.00	.47
Standard & Poor's: 1960			
TA	.0350	5.43	.23
NW/TD	.289	4.06	.38
P/WC/S	−.506	−4.08	.42
OI/S	4.570	3.11	.47
P/S/NW	−.223	−1.38	.48
Moody's: 1959			
TA	.0383	6.46	.23
P/S/NW	−.393	−3.85	.35
NW/TD	.234	4.11	.41
OI/S	3.965	3.58	.44
P/WC/S	−.334	−2.98	.46
Standard & Poor's: 1959			
NW/TD	.328	4.51	.24
TA	.0365	5.54	.38
P/S/NW	−.406	−2.59	.43
P/WC/S	−.378	−3.02	.46
OI/S	3.724	2.79	.49

* The TA regression coefficients are based on adjusted total-assets figures. The decimal place of total-assets data was shifted to the ten-millionth dollar position. For example, total assets of $152,546,000 would have been read as $1.52546. This applies to other tables also.

erent models for each group.[25] The bulk of the subordinated bonds were in the lower rating categories, and so there was really one model for low ratings and another for high ratings. This approach seemed too cumbersome to be of normative value to analysts, and so it was rejected in favor

[25] For a complete description, see an earlier unpublished version of this paper: James O. Horrigan, "The Prediction of Corporate Bond Ratings with Financial Ratios" (paper delivered at TIMS Meetings, Eastern Section, Rochester, N.Y., October 14, 1965). Copies are available from the author.

TABLE 8

The Relationship of Corporate Bond Ratings to Total Assets, Four Financial Ratios, and Subordination Status: 1960

Variable	Regression Coefficient	*t* Value of Reg. Coef.	Multiple Coefficient of Determination
Moody's			
SUB	1.225	9.30	.40
TA	.0328	5.69	.51
OI/S	4.346	3.92	.57
NW/TD	.203	3.46	.60
P/WC/S	−.367	−3.51	.63
P/S/NW	−.334	−2.90	.65
Standard & Poor's			
SUB	1.197	7.54	.33
TA	.0337	5.20	.46
NW/TD	.272	3.74	.55
P/WC/S	−.501	−4.05	.58
OI/S	4.519	3.09	.62
P/S/NW	−.203	−1.26	.63

of the other approaches. The second approach, arbitrarily raising the subordinated ratings one point, is the most appealing because it allows the focus of the analysis to remain on accounting data. However, it did not work well. It tended to underpredict the ratings, which suggested that the adjustment of the subordinated ratings should have been larger than one point. It was not possible to determine arbitrarity the proper adjustment. Therefore, by a process of elimination, so to speak, the first approach of using a dummy variable representing subordination status was adopted.

The addition of the subordination dummy variable improved the results considerably. The regression function of the model determined above, plus this variable, is presented in Table 8. These results tend to "swamp" the role of accounting data, and the financial ratios in particular, because the dummy variable is also intercorrelated with the other independent variables.[26] However, the ratios did explain approximately 30 per cent of the unexplained variance remaining after the addition of the subordination and total-assets variables. In general, it would appear as though an analyst could correctly predict almost two-thirds of a new set of ratings with this model. This was the final model developed in the study, and it served as the basis for predicting the ratings of new samples.

[26] For example, the correlations of SUB with the other variables in the Moody's sample were as follows: TA, .22; NW/TD, .36; P/WC/S, −.04; P/S/NW, −.20.

TABLE 9

Bond Rating Prediction Indexes

Rating	Mean Index	Interval
	Moody's	
IX	3.839	>3.098
VIII	2.358	>1.994 <3.098
VII	1.630	>1.353 <1.994
VI	1.076	> .696 <1.353
V	.327	> .262 < .696
IV	.197	< .262
	Standard & Poor's	
IX	3.499	>2.855
VIII	2.211	>2.094 <2.855
VII	1.978	>1.602 <2.094
VI	1.225	> .838 <1.602
V	.452	> .360 < .838
IV	.268	< .360

Third stage: predicting new sets of ratings.—The regression coefficients of this final model were then used to develop indexes for predicting new sets of rating data. As described earlier in this paper, these indexes are the means of the estimated dependent variables within each rating class, and the intervals of the indexes are half of the distance between the means of adjacent rating classes.[27] The interval indexes which were developed are presented in Table 9.

Similar interval indexes were computed next for each firm in the second set of samples. Data two years and one year in advance of the new ratings and the rating changes were used. The one-year lead data were slightly better predictors, and so they received the most attention. The rating predictions were obtained by comparing the computed indexes of each firm with the interval indexes derived from the original samples. For example, if a firm's index was 1.50, its Moody's rating would have been predicted as VII because the index falls within the interval $> 1.353 < 1.994$. These prediction results are presented in Table 10.

Although the percentage of correct rating predictions is not quite as high as the multiple correlations in the original sample, the overall results still seem very good. Approximately 58 per cent of the Moody's new ratings and 52 per cent of the Standard & Poor's ratings were predicted correctly, and most of the remaining predictions were within one rating. Additionally, approximately 54 per cent of the Moody's changed ratings and 57 per cent of the Standard % Poor's ratings were predicted correctly;

[27] The regression functions' intercept constants have been left out, but for the interested reader they were as follows: Moody's, 4.84; Standard & Poor's, 4.85.

TABLE 10

The Differences between Bond Ratings Predicted from Accounting Data One Year in Advance and the Actual Ratings: 1961–64

Actual Rating	Number of Ratings Prediction Differs from Actual Rating							Total
	−3	−2	−1	0	1	2	3	
Moody's: New Ratings								
IX				1				1
VIII				1				1
VII			4	10				14
VI		1	4	4	1			10
V			10	16	4			30
IV				9	5			14
		—	—	—	—			—
		1	18	41	10			70
Standard & Poor's: New Ratings								
VIII		1			1			2
VII			3	6	1			10
VI		3	6	5	3			17
V			7	14	1			22
IV				6	3			9
		—	—	—	—			—
		4	16	31	9			60
Moody's: Changed Ratings								
VIII				3				3
VII			2		3			5
VI				3	2			5
V			2	3	1	1		7
IV				5			1	6
			—	—	—	—	—	—
			4	14	6	1	1	26
Standard & Poor's: Changed Ratings								
IX			2					2
VIII		3		7	1			11
VII				1	2			3
VI			3	4	2			9
V			3	5		2		10
IV				11			1	12
		—	—	—	—	—	—	—
		3	8	28	5	2	1	47

and once again, most of the remaining predictions were within one rating. Naïve prediction models utilizing prior distributions of bond ratings and random-number series tended to yield about 30 per cent correct predictions, and the spread of erroneous predictions was much wider. Thus, these prediction results would seem to be significant.

The changed ratings' prediction results are probably slightly better than indicated in Table 10. Many of the changes were decreases to a rating of III, but there were no III ratings in the original Moody's sample and only two in the Standard & Poor's sample. Therefore, there were not enough data available to warrant a formal presentation of rating-III predictions. However, an analysis of the two III ratings in the Standard & Poor's sample would suggest that an index for III ratings would begin approximately at $-.500$. Using that arbitrary index, one additional Moody's change to rating III was predicted correctly, and seven out of eleven similar Standard & Poor's changes were predicted correctly. These results would have raised the previous correct predictions to 57 per cent for Moody's and 59 per cent for Standard & Poor's.

The prediction results in regard to the bond-rating changes should be viewed mainly as a test of the model with a new set of data, rather than as a test of the model's power to predict the *timing* of changes. To establish that power, the results would have to be much better and a control group would be necessary. However, the model is not useless in this regard; it could be used to evaluate the validity of rating changes.

In regard to the predictions of new bond ratings, there is one obvious weak spot in the model: it tends to underestimate rating VI. This is a serious shortcoming, because rating VI is the cutoff point of the so-called "investment class" bonds. Bonds rated below VI cannot be purchased by certain types of financial institutions, and so that rating can have an important effect on the prospective market for a bond issue. Therefore, it would be desirable to have a sharp difference between ratings VI and V in the model. Perhaps this problem is a fault of the model, or perhaps it is a fault of the rating process itself. In any case, it is worth further exploration.

However, it is felt that this model could be used by an analyst in its present form. It held up through 1964 data and should continue to do so for a few more years. Eventually the total-assets variable would shift too far away from the original data, and it would have to be revised. But, this would involve only a change in the regression coefficients and not a change in the variables. A more important change may occur in regard to the subordination-status variable. Subordinated bonds are becoming more popular in new-bond issues, and it is quite likely that the effect of this variable will lessen in the future. But, the fundamental model made up of total assets and financial ratios should remain useful.

Of course, improvements and refinements are possible in any analysis. Some possibilities in this study are the following: First, different types

of ratios may perform better. Newer types of ratios, such as ratios employing fund-statements data, could be substituted for some of the ratios in this study. Also, trends of ratios might be used rather than cross-sectional relationships; and, finally, different industry data could be tried. Second, adjustments of the underlying accounting data might be useful. For example, such adjustments as converting the data to a constant dollar basis, capitalizing leases, and other such types of adjustments might provide better data for calculating ratios. This would provide an added bonus. Replications of studies of this type would provide empirical tests of the utility of these proposed changes in accounting procedures. Finally, different statistical methods may well improve the results. In particular, given the nature of the dependent variable, discriminant analysis should be a promising approach.

Also, rather than merely improving the basic features of this study, it would perhaps be possible to develop an entirely different analysis, using nonaccounting variables, which would yield better predictions. In this regard, however, it is well to keep in mind that accounting data and financial ratios have a distinct advantage over most other types of data: the accounting data are easily available for virtually all firms and the ratios are easy to compute.

CONCLUSION

In conclusion, accounting data and financial ratios have been found to be useful for the determination of corporate-bond ratings. Total assets, a long-term solvency ratio, a short-term capital-turnover ratio, a long-term capital-turnover ratio, and a profit-margin ratio, plus a dummy legal-status variable, are sufficient to correctly predict over one-half of samples of bond ratings. Therefore, it is concluded that financial ratios and accounting data can be useful in long-term credit administration.